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# **ECOLOGO-GEOGRAPHICAL ATLAS AS A MODEL OF STABLE DEVELOPMENT OF REGION: CHOICE AND TREATMENT OF INFORMATION PRINCIPLES**

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## **Abstract**

As a model the expression of the conception becomes "Ecologo-Geographical Atlas of the Tatarstan Republic" providing integral, complete and balanced views of the environmental condition.

The work is conducted with "floating" set of geographical information (indicators) which allows to stress a specificity of objects. The procedure permits to elaborate system of diagnostic indicators. System of indicators is chosen so that it reflects all aspects of complex socio-ecologo-economical state and situations of the region and with the help of our special method it is transformed into the corresponding regional syndrom for every region.

On the whole, the Atlas gives a perspective sight of reflection of the present day ecologo-economical condition and orients specialists and authorities to take timely and effective management decisions in the field of regional policy.

## **1. Introduction.**

At the Tatarstan Republic (RUSSIA) there used the programmes of socio-economical, ecologo-economical, informational, etc. development and recreation at the level of global, federal and regional scales which should begin to work, in order to elaborate general ecologo-economical policy by means of conception of balanced state and stable development of a region.

## **2. Regional Ecologo-Economical Policy.**

Ecological situation in the Tatar Republic is extremely tense. This problem may be realised in the context of integrated or complex ecologo-economic systems. Since in 1980 the International Bank (Washington)(Hodgson, 1991) has accepted in its investment policy a position, expressed now in the law of "two E" (ecology and economy), approaches to study the condition and ways of the improvement of the environment have begun to have complex character, and as an object of study complex ecologo-economic systems (CEES) have begun to act. Main principles of their study are:

- Adequate coordination at all levels of the ecological and economic programs of development of regions.

- Valuation of a parity of requirements of manufacture with opportunities of natural environment and condition of a social infrastructure.

Clearly, the ecologo-economic policy assumes development of measures on achievement of some harmony in development of nature and society; on protection of health of people from negative ecologo-economic effects; on rational use and restoration of natural resources; on creation legal, economic and social bases of organization of protection and improving of the environment.

Within the limits of the ecologo-economic approach, the following problems should be considered first of all (Trofimov, Shagimardanov, Petrova, 1996):

- Development of effective and competitive directions of specialization of economy of a territory, is the most complete way fitting the resource potential, preconditions and local conditions, ecologo-economic orientation, optimum combination of ecological and economic interests.

- Ensuring economic and complex use of resources and preservation of the environment in conditions of variety of the forms of the property.

Taking into account the aforesaid, problems, requiring the most deep researches are allocated. In the field of territorial aspect of study of ecologo-economic systems and improving of the environment, the main are:

- Conformity of modern accomodation of productive forces to conditions and factors of accomodation in view of potentialities of the environment, and ecological capacity of a territory.
- Large-scale ecologo-economical regionalizing in order to estimate environ-mental condition, main directions in plans of protection and improvement of the environment.

These aspects in full measures can be realized in the Ecology-Geographical Atlas of the Tatarstan Republic. However while constructing integral (complex) maps there appear their own peculiarities and difficulties.

### **3. Conceptual Aspect.**

One of the peculiar features of the development of Complex Ecology Economical Systems (CEES) lies in the fact that it occurs in the "washed out" situation - in the bounds of "washed out" relations. It results in specific difficulties while solving many problems. Under these conditions it is not quite easily to formulate the aim (criterion) of the solution rather correctly, the conditions of a problem may be formulated indistinctively and so on.

The problems of making decisions of solutions in the conditions of vagueness cannot be in the main reduced to strict formal aims: the possibilities of strict quantitative methods in those situations are restricted formal and less formal approaches of initial ecology-geographical information analyses being pushed in foreground (the theory of fuzzy sets, theory of expert estimates, and others).

The notion of "washing out" allows coming to a considerable extent in a new way to the idea in geographical space signs (GSS). If a geographical situation is being considered as any point of GSS then that situation should be admitted "washed out" as well, i.e. that point's location in the space is not definitely determined due to "washing out" of certain coordinates. In a "washed out" space the point is degenerated into a "spot" with obscure configurations. Any type of approaches of purposeful affect on geosituation will be equal to the approach to move the "spot" corresponding to that situation to a set position. Due to obscure contours of the "spot" such displacement will mean solving of the problem in the conditions of vagueness, which, by all means, represents a primary peculiarity of many problems of cartography modelling. It is essential that such problems, in the main, cannot be described by stringent mathematical methods. In this case it is necessary to use a specific language for the results describing of notion and terms types of the theory of the fuzzy sets, whose metaphisical apparatus is based in main on pithy aspects of the investigated problem and for account of that

it enables to formalize less formal situations involving one or other hypothesis. In the case of GSS it means the removal of "washing out" of the space, i.e. transformation of a spot into a point and this allows to form a metrics of that space.

The problem of "washing out" of the geographical boundaries and the estimate of their significance in a cartographic modeling has the same difficulty. However this problem has sufficiently well been developed by cartographers and mathematicians. In this connection the problem of adequacy of the methods of treatment geographical information and maps construction to a pithy concept of Atlas maps construction and the problem itself of developing this method as well acquires a great significance.

#### **4. Ecologo-Geographical Atlas as a Model Expression of Conception of Balanced and Stable Development of a Region. Adequate Methods.**

The main task of the ecology nowadays can be defined as a problem of studying processes of exhaustion of vitally important resources, their distribution among human population and elaboration of methods of preservation and distribution favouring prolongation of life-time of human civilization. In this regard, corrected programs of socio-economical, ecologo-economical, informational, etc. development and recreation at the level of global, federal and regional scales should began to work, in order to elaborate general ecologo-economical policy by means of conception of balanced state and stable development of a region.

As a model expression of the conception becomes "Complex Ecologo-Geographical Atlas of a territory", providing integral, complete and balanced views of the environmental condition.

Judging from a number of researches in the field of ecological monitoring, valuation of a condition and forecast for steady development, in the bases of the integrated characteristic of a condition of the environment it is expeditious to put a parameter ecologo-economical syndrom of a territory. It is a characteristic of potential opportunities of the environment on a way of its preservation and improvement.

As a base of ecologo-economical map, map of ecological situations, map of ecologo-economical syndrom, etc. of the TR the most adequate is the principle of determination of ecologo-economical syndrom of a territory. Its advantage is in ability of the description of hierarchical model of mutual relation of various environments, spaces, surfaces and parameters.

## **The Structure of "Ecologo-Geographical Atlas of the Tatar Republic".**

### **I. Introduction Part.**

1. Republic of Tatarstan (general map).
2. Administrative division.
3. The map of the ecological investigation of the TR.

### **II. General Part.**

4. Geology map.
5. Climate.
6. Phisico-geographical environment and landscape.
7. Hydrology net.
8. Soil.
9. Geomorphology map.
10. Map of Quaternary deposits.
11. Phenology map.

### **III. Natural Resources.**

12. Mineral resources.
13. Forest resources.
14. Water resources (open water).
15. Hydroresources (underground and mineral waters).
16. Water bioresources (ichthyofauna).
17. Land bioresources (fauna).
18. Land resources.
19. Land use.

### **IV. Demographical and Social Aspects (Social aspects of control of political, ecological, etc. Programs).**

20. Social potential of the TR.
21. Science potential.
22. Integral potential (social-economic landscape).
23. Health resorts, sanatoria, rest homes, tourist centres.

### **V. Population.**

24. National structure.
25. Density of population (urban and rural population).
26. Demography streams.
27. Social indicators.

## VI. Aspects of Industry and Agriculture.

- 28. Economic map of the TR (with TPC, major economic, industry and other areas)
- 29. Economic links (interregional, with the regions of Russian Federation, with the states of CIS and foreign ones).
- 30. Privatisation and development of new economic structures.
- 31. Diffusion of innovations.
- 32. Integral ecologo-geographical regionalization.

## VII. Ecology and Geoecology.

### A. 33. State of soil.

- 34. Ecology of air.
- 35. Ecology of water objects.
- 36. Ecology of forest areas.
- 37. Refuses (dust) pollution.
- 38. Ecology component of water biota.
- 39. Ecology component of land biota.

### B. 40. Pollution (Integral) of Environment.

- 41. Ecological map (map of the ecological situations).
- 42. Ecologo-economical map.
- 43. Extremal areas and zones.
- 44. Distribution of the main illnesses, connected with ecology of environment.
- 45. Regions with unfavourable ecology on a man health.

## VIII. Radiation-Ecological Part.

- 46. Nature radiation background.
- 47. Radiation of soil.
- 48. Radiation of water objects.
- 49. Distribution of the man artificial radionuclein.

## IX. Anthropogenic Stress on Nature.

- 50. Map of the integral anthropogenic stress.
- 51. Distribution of the local objects of pollution.
- 52. Estimation of the anthropogenic stress nearby city agglomerations.

## X. Especially Preservation Areas.

- 53. Especially preservation areas.
- 54. Natural and historical monuments.
- 55. Ecology aspect of island systems and fleet-water.

## XI. Part "Ethnology".

### 56. Map of ethnoecology of the TR.

The work is conducted with "floating" set of indicators which allows to stress a specificity of objects. The procedure permits to elaborate system of diagnostic indicators. Its goal - to obtain such interconnected set of indicators for each unit (operational-territorial unit, or OTU) that is will show the reatest distinction with other OTU of the totality. Such set is called the regional syndrome of indicators (Kaganski, Novikov, 1989). The ecologo-economical syndrom then can be determined by a definite ecologo-economical set of diagnostic indicators.

Each indicators of the syndrom is considered as a component of OTU content, as the way to show the fact and mere distinctions between OTU and, finally, as the index of OTU specificity. Hence, the index of the syndrom - is an integral characteristic of the specific ecologo-economical orientation of a given unit of a territory.

Atlas complex (integral) maps construction includes three steps.

The first step defines diagnostic indicators which latter are used for the estimate of ecology-economical syndrom and maps construction for this purpose taxonomy distances are determined by every significance for every OTU with the help of the expression

$$T_{j=1}^k = \left( \sum_{i=1}^n (x_k^i - x_j^i)^2 \right)^{1/2},$$

where:

$T_j^k$  - rates distances of the OTU by the significance i;

$x_k^i$  - meaning of the significance i in the OTU k;

$x_j^i$  - meaning of the significance i in the all rest OTU in order.

Then the matrix of taxonomy distances with the measures: "OTU X significance" is determined.

The regional syndrom is defines by the following means. For every OTU only those significances whose values  $T_j^k$  - are higher of their average value at a given OTU, i.e.  $T_j^k > x_k^i$  are chosen for every OTU.



After that two types of regional syndrom maps can be constructed: either discrete (cartograms) or continual (with the help of isolines; by the sum  $\sum T_j^k$ ).

At the second step the maps are constructed with the help of the sums of "weighed" balls.

At first all the significances are normalized with the help of balls by the single scale. Then the matrix of balls ( $B_i$ ) is constructed with the values of "significances X OTU". Then the "weighed coefficients ( $\alpha_i$ ) are defined by means of correlation of every significance to the main one chosen by the pithy principle. The "weighed" coefficient is defined by the equation  $\alpha_i = r_i/r_{\max}$ , where  $r_{\max}$  - is the maximum value from the obtained correlation coefficients.

"Weighed" balls ( $Bw_i$ ) are calculated as the ball's product to the corresponding of "weighed" coefficient, i.e.  $Bw_i = \alpha_i B_i$ . Then the matrix of sums of "weighed" balls with values is constructed "significances X OTU".

As at the first step maps can be both of discrete form (cartograms) and continual form (isolines).

At the third step a special analysis of significance distribution is done. At this step the work is carried out only with the maps of continual character of the type of "statistical relief" (statistical surface) permitting a unified treatment of geographical data. Those are the more stringent ways of "smoothing out" the statistical relief with the aim of search of a trend surface as the "norms" of the significance distribution and special marking out of "response" surfaces as well and their interpretation from the point of the concept of critical zones and "risk" zones" marking out.

The ecology orientation maps are constructed on the base of economical map with consideration for the system of indicators of environment condition, of ecological load of different character, indicators of sickness rate of population and a number of indicators reflecting complex character of the influence of ecological situation.

System of indicators is chosen so that it reflects all aspects of ecologo-economical state and situation of the region, and with the help of the method described above it is transformed into the corresponding regional syndrom for every region. On the whole, Atlas gives a perspective sight of reflection of the present day ecologo-economical condition and orients specialists and authorities to take timely and effective management decisions in the field of regional policy.

## **5. Conclusion.**

It is possible to consider CEES as a hierarchical system, carrying out coordination of interactions of population, nature and manufacture on a territory or as a system of the coordination of interests, permits to use means of the general theory of systems, and on this basis - to research of dynamics of territorial ecological, economical, etc. processes on computer models.

It is supposed, that the technological basis of such models should be provided by dynamic graphic of territorial processes - totality of programm and mathematical means, organized in System of Modelling of the Environment (Trofimov, Gnedenkov, 1988).

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